

Marine Aviation Requirements Study: Peacetime Requirements Analysis

Anthony M. Jareb



4825 Mark Center Drive • Alexandria, Virginia 22311-1850

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Mark B. Geis, Director
Naval Operations and Support Team
Integrated Systems and Operations Division

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Summary

This research memorandum describes how CNA derived peacetime squadron requirements for the Marine Aviation Requirements Study (MARS). The MARS was tasked to determine Marine Corps aviation requirements, with an emphasis on aircraft, based on major theater war (MTW), small-scale contingency (SSC), MEU(SOC) operations, and peacetime requirements for the 2015 time frame.

We based our peacetime squadron requirements analysis on recent deployment and exercise support patterns of active force squadrons. We assume that these commitments, which define the peacetime operating tempo, will be about the same in the 2015 time frame. Reserve force structure is primarily driven by major theater war requirements.

We counted up the number of squadron equivalents that are required to conduct rotational deployments, by type/model/series (T/M/S) aircraft. We multiplied those squadron-equivalents by a factor of 3 or 4, depending on the T/M/S, to account for the rotation base needed to meet rotational deployment commitments continuously. We then added a number of squadron equivalents that typically are involved in supporting exercises that involve other forces—that is, exercises that are more than just a single squadron’s training evolution.

This analysis implies that a range of squadrons, for each T/M/S, is needed to meet peacetime requirements. We use the mid-point of our peacetime squadron requirements analysis to combine with other analysis to estimate the total Marine aircraft requirement.

Table 1 summarizes the results of our peacetime squadron requirements analysis. The table presents a point estimate of the peacetime squadron requirement. We assume that rotary-wing and VMM squadrons will use a 4:1 rotation base, and that fixed-wing squadrons will use a 3:1 rotation. These assumptions are similar to current practice.

Table 1. 2015 peacetime squadron requirement, by T/M/S

Squadron type	Aircraft	Peacetime requirement
VMM	MV-22	19
HMH	CH-53E	6
HMLA	AH-1Z, UH-1Y	8
JSF	JSF	24
VMAQ	EA-6B	4
VMGR	KC-130	3

We assume that VMM squadrons will support the same rotational deployment and exercise support commitments that HMM squadrons support. We examined several assumptions for translating VMA/VMFA/VMFA(AW) peacetime squadron commitments into future JSF squadron requirements. The JSF squadron requirement reported in table 1 is based on 12-plane JSF squadrons and supporting MEU deployments with an entire JSF squadron.¹

1. Our analysis of MEU aviation combat element (ACE) structure is found in [1]. The size of the JSF detachment in the 2015 MEU ACE is discussed in more detail there.

Introduction

This research memorandum documents the peacetime squadron requirements analysis for the MARS. The MARS was sponsored by the Deputy Commandant for Aviation and the Deputy Commanding General for Combat Development, Marine Corps Combat Development Command, who asked CNA to help the Marine Corps determine its aircraft force structure requirements in the 2015 time frame. This research memorandum is one in a series of reports that document various detailed analysis for the MARS, [1–3]. There is also a summary report, [4].

The Marine Corps' aviation force structure must accommodate aviation requirements for different types of MAGTFs and different levels of operations. The MARS separately analyzed Marine aircraft requirements for MTWs, SSCs , MEU operations, and peacetime operations. Overall Marine aviation force structure requirements are also described in [4].

Analytic objectives and issues

The purpose of this analysis is to determine the number of squadrons, by T/M/S that the Marine Corps needs to meet its peacetime operational requirements. The primary determinants of peacetime aviation squadron requirements will be the Marine Corps' rotational deployments, aviation training support to other Marine forces, and accommodation for fulfilling these needs while also building and maintaining individual and unit capabilities through squadron training.

Analytic approach

We make a key assumption about the nature of peacetime operations in the 2015 time frame. We assume that the current level of rotational

deployments and effort to support training of other Marine forces in 2015 will be very similar to that in today's peacetime operations. We have no firm basis for predicting or speculating that requirements will be very different in 15 years. We believe that the Nation will continue to make the forward-deployed presence of naval forces a key element of its National Military Strategy for the foreseeable future. We believe that the combined arms philosophy that underpins Marine Corps capabilities will continue to drive MAGTF training requirements, which make up a significant portion of peacetime aviation operations.

We used historical data from FY 1998-2001 and Marine Aircraft Wing training exercise and employment planning (TEEP) data for FY 2001-02 to quantify the peacetime squadron operational requirements, by T/M/S. Because the Joint Strike Fighter (JSF) will replace three T/M/S, we performed additional analysis to translate AV-8B, F/A-18C, and F/A-18D operational requirements from the present day to future JSF squadron requirements.

Reserve forces

Our peacetime squadron analysis focuses on the active force. However, reserve aviation squadrons provide critical support to Marine peacetime operations and actively train with active forces. Reserve squadrons:

- Fulfill taskings and operational commitments that would otherwise be unmet because active forces are already committed to other operations and activities
- Provide operational tempo (OPTEMPO) relief to active forces

We did not include reserve squadrons in our analysis because their primary role—the justification for reserve force structure—is to augment and reinforce active forces in time of war. Our analysis of peacetime squadron requirements, thus underestimates somewhat, the total force structure requirements of Marine aviation.

Rotational deployment cycle

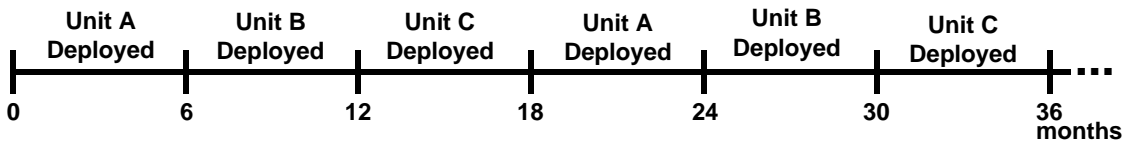
The Marine Corps is an expeditionary force that focuses on maintaining a uniformly high state of readiness. The Marine Corps does not tier its active force units into different readiness categories by allocating more resources to some units than others. The Marine Corps forward deploys and forward bases a significant portion of its forces. The bulk of the forward-deployed and forward-based forces are part of a rotational deployment system that sends units, as units, overseas on land and amphibious ships for six-month deployments.

The Marine Corps supports these rotational deployments with a “rotation base” of units. The deployed unit or just-about-to-deploy unit may be at peak readiness and have priority over other units in access to certain training ranges and the like. But the units in the rotation base are still provided sufficient resources and are expected to be able to deploy and fight on short notice.

A 3:1 rotation cycle

A 3:1 deployment rotation cycle or rotation base refers to a situation in which a single rotational deployment is supported by three units. That is, each of the units in the rotation base will be assigned every third deployment, in turn. For a six-month deployment, a given unit in the rotation base, would be deployed six months, then back at its home station for 12 months before deploying again, and so on. Figure 1 depicts this deployment cycle for units A, B, and C supporting a six-month deployment.

Figure 1. Notional unit deployment time line for 3:1 rotation base

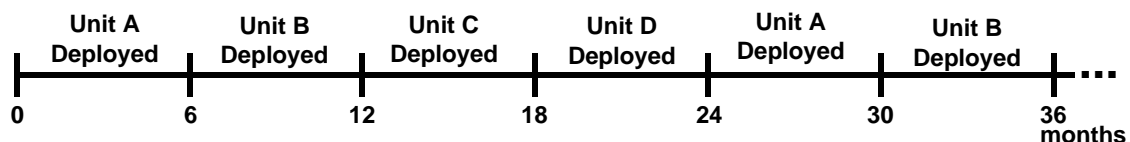


In reality, depending on the deployment, there may be a bit of overlap between successive deploying units. Also, nominal six-month deployments may not always be exactly six months long.

A 4:1 rotation cycle

A 4:1 deployment rotation cycle or rotation base refers to a situation in which a single rotational deployment is supported by four units. That is, each of the units in the rotation base will be assigned every fourth deployment, in turn. For a six-month deployment, a given unit in the rotation base, would be deployed six months, then be back at its home station for 18 months before deploying again, and so on. Figure 2 depicts this deployment cycle for units A, B, C, and D supporting a six-month deployment.

Figure 2. Notional unit deployment time line for 4:1 rotation base



Here also, depending on the deployment, there may be a bit of overlap between successive deploying units. Also, nominal six-month deployments may not always be exactly six months long.

A 4:1 rotation base is more desirable than a 3:1 rotation base from the viewpoint of quality of life and personnel tempo, and therefore a 4:1 rotation base is more easily sustained over long periods of time.

Training exercises

In addition to rotational deployments for forward presence, we include training exercises in our analysis of peacetime squadron requirements. We do not include training conducted by just one squadron for just that squadron's individual and unit training. Instead, we include training exercises that involve ground forces, larger aviation-only exercises, and major exercises conducted by higher headquarters that require Marine aviation participation.

The data

This section describes the data we used to determine current squadron rotational and training deployment activities.

We organized the deployment and TEEP data by T/M/S, type of deployment, and deployment length rounded to nearest whole months. This allowed us to build a squadron deployment profile for each T/M/S for FY 1998–2002, which is the basis for determining peacetime requirements.

For those T/M/S that do not deploy as full squadrons, we used a fractional factor to create a squadron-equivalent deployment profile. For all T/M/S we used a fractional factor for exercise support to other forces and deployments for squadron training, because often these deployments are made by less than full squadrons. We used a different standard factor for each T/M/S (based on deployment practices), because our data did not always include information on how many aircraft were deployed on a particular exercise or how many are planned for a future exercise.

Historical data, FY 1998-2001

We compiled the activities of squadrons by T/M/S for the past 2 ½ fiscal years from a Marine Corps deployment database developed at CNA, and supplemented gaps in that data with information from other sources, such as earlier studies that examined deployment patterns. The USMC deployment database developed at CNA is based on Headquarters, Marine Corps operational summaries (OPSUMs) as its primary source of deployment information.

Our deployment data are incomplete, particularly for exercise and training deployments. The past employment data include very few deployments of this type, and the TEEP information does not reflect all the exercise and training activity that is likely to occur in late FY 2002 at this time. To estimate exercise support requirements we focused on FY 2001 exercise support plans, which are the most complete sources of information we have.

Squadron deployment planning, FY 2001-02

We also obtained TEEPs from the 1st, 2d, and 3rd Marine Aircraft Wings (MAWs). The TEEPs indicate which squadrons will be deployed on each rotational deployment for up to three years in the future. Planned participation in major exercises is also included in the TEEP, but is typically known only about one year ahead of time.

Current structure and deployment patterns

This section describes the current Marine aviation squadron structure and current squadron rotational deployment patterns by squadron type. The rotational deployment patterns are derived from recent historical data and deployment plans for the near future. We also discuss how 16-plane VMA and 12-plane VMFA/VMFA(AW) peacetime requirements can be translated into JSF squadron peacetime requirements.²

HMM

Structure

There are currently 14 HMM squadrons in the active force. Each HMM squadron includes 12 CH-46Es. As the MV-22 is fielded, HMM squadrons will be re-designated as VMM squadrons. VMMs will include 12 MV-22 aircraft.

The HMM active squadrons are based as follows:

- Six squadrons are permanently assigned to the 2d MAW and based at MCAS New River, NC.
- Six squadrons are permanently assigned to the 3rd MAW, three of which are based at MCAS Miramar, CA, and three based at MCAS Camp Pendleton, CA.
- Two squadrons are permanently assigned to the 1st MAW and based at MCAS Futenma, Okinawa, Japan.

2. The Marine Corps intends to replace all its AV-8B, F/A-18A/C, and F/A-18D aircraft with the JSF.

For many years there were 15 HMM squadrons in the active force. In 1999 HMT-204, the CH-46E training squadron based at MCAS New River, NC, was redesignated as VMMT-204, the MV-22 training squadron, and HMM-164 was redesignated as HMM(T)-164, to fill HMT-204's role. The Marine Corps will maintain two medium lift training squadrons while they continue to operate two different aircraft during transition from CH-46Es to MV-22s. Ultimately, the 14 HMM squadrons and HMM(T)-164 will be converted into 15 VMM squadrons.

Deployment patterns

Rotational deployments

The HMM squadrons support three rotational MEU deployments:

- The 2d MAW supports one six-month rotational MEU deployment aboard amphibious shipping from the east coast of the United States to the Mediterranean.
- The 3rd MAW supports one six-month rotational MEU deployment aboard amphibious shipping from the west coast of the United States to the Western Pacific.
- The 1st MAW supports the 31st MEU, which is permanently based on Okinawa and periodically deploys aboard amphibious shipping for up to weeks at a time. One of the two HMM squadrons on Okinawa is assigned to the 31st MEU on a rotating basis for six months at a time.

Typically some deployments overlap during successive MEUs' turnover, and the 31st MEU is not always deployed. Thus, there are typically three HMMs employed on rotational MEU deployment, but at times there are as few as two or as many as four.

HMMs always deploy as full 12-plane squadrons in support of MEUs. The MEU aviation combat element (ACE) is a reinforced HMM, that is, an HMM squadron with detachments from other T/M/S squadrons.

Exercise support

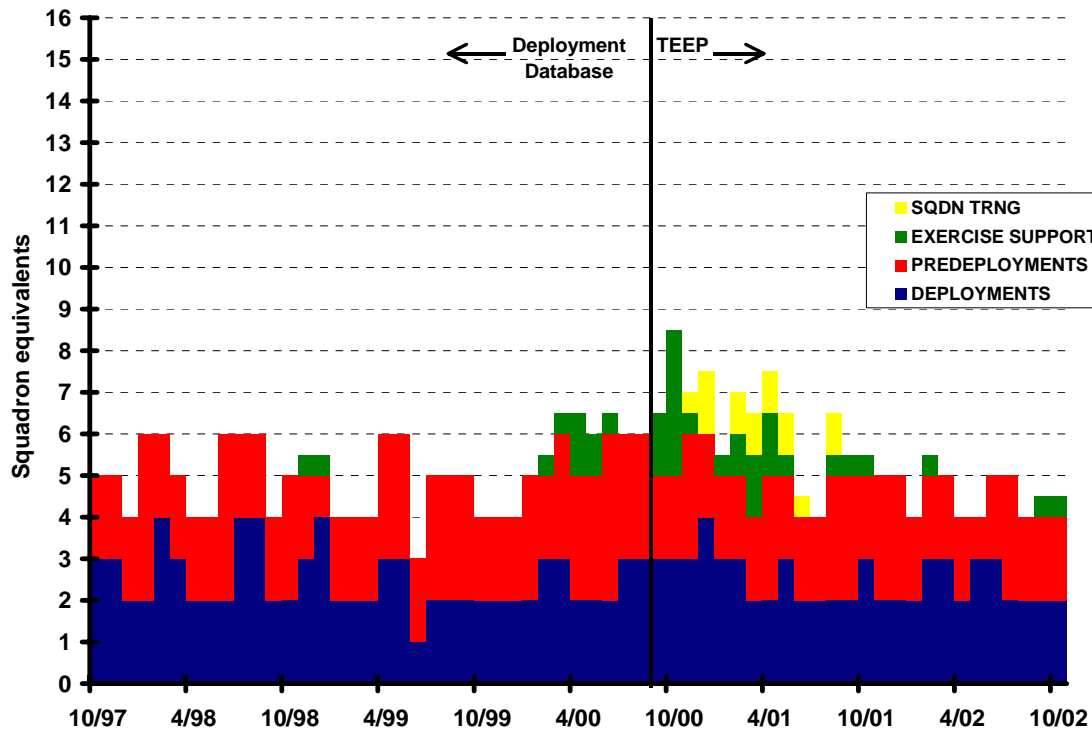
There is a significant, continual training deployment requirement for HMM squadrons. There is a six-month pre-deployment training work-up for MEUs, which includes a significant amount of time deployed away from home station. Further, the CH-46E (and MV-22 in the future) are the primary helicopter troop transport, i.e., a primary maneuver capability for Marine infantry, and participate in almost every major exercise involving ground forces. Often, training exercises away from the home station are supported with less than a full squadron. Based on our knowledge of Marine Corps exercises we assumed that half a squadron supports these exercises.

Deployment profile

Figure 3 shows the HMM deployment profile for FY 1998-2002 that we developed. The vertical axis shows squadron-equivalents devoted to the various categories of deployments. As discussed above, we used a factor of 1 for HMM deployments and the pre-deployment training work-ups (i.e., the entire squadron deploys), and a factor of 1/2 for HMM exercise support (i.e., half a squadron, on average, supports each exercise commitment).

The Marine Corps deployment database developed by CNA has little information on aviation squadron exercise support. The primary sources we used included little of this information. Therefore, our squadron-equivalent exercise support requirement is derived primarily from TEEP information for FY 2001. These data show that 2–3 squadron equivalents are typically devoted to exercise support.

Figure 3. HMM deployment profile, FY 1998-2002



Peacetime squadron requirement

HMM squadrons support their rotational deployments on something close to a 4:1 rotation base. We estimate the peacetime squadron requirement to be:

Deployed squadron equivalents	3 - 4
4:1 rotation base multiple	<u>x 4</u>
	12-16
Plus exercise support	<u>2-3</u>
Total peacetime requirement	14-19

HMH

Structure

There are currently nine HMH squadrons in the active force. Six have 16 CH-53E heavy-lift helicopters, and three have 10 CH-53D medium-lift helicopters.

The HMH squadrons are based as follows:

- Two squadrons are permanently assigned to the 2d MAW and based at MCAS New River, NC. These squadrons fly CH-53Es.
- Four squadrons are permanently assigned to the 3rd MAW and based at MCAS Miramar, CA. These squadrons fly CH-53Es.
- Three squadrons are permanently assigned to the 1st MAW and based at MCAS Kaneohe Bay, HI. These squadrons fly CH-53Ds.

Deployment patterns

Rotational deployments

HMH squadrons support three rotational deployments:

- The 2d MAW supports one six-month rotational MEU deployment aboard amphibious shipping from the east coast of the United States to the Mediterranean. This deployment is supported with a four-plane detachment from an HMH.
- The 3rd MAW supports one six-month rotational MEU deployment aboard amphibious shipping from the west coast of the United States to the Western Pacific. This deployment is supported with a four-plane detachment from an HMH.
- The 3rd MAW also supports one six-month rotational deployment to Okinawa, Japan, as part of the unit deployment program (UDP). This forward-deployed HMH squadron provides a four-plane detachment to the 31st MEU.

- The HMM squadrons on Hawaii do not currently participate in any rotational deployment.

Typically one full squadron and two four-plane detachments are deployed. Therefore 1-1/2 squadron equivalents are typically deployed at any given time, and 1/2 squadron equivalents in the six-month MEU pre-deployment training work-up.

Exercise support

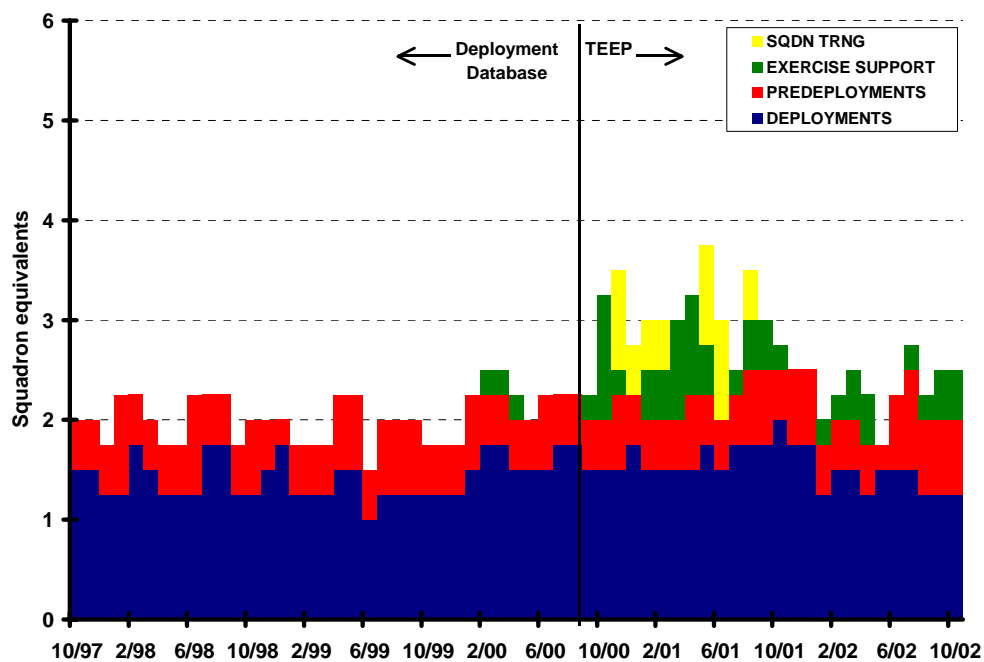
HMM squadrons are also typically involved in exercise support for ground forces, as they are the primary heavy-lift transport for Marine ground forces. Generally, exercises are supported with small HMM detachments. Based on our knowledge of Marine Corps training, we assume that 1/4 squadron equivalent is typically provided to support exercises.

Deployment profile

Figure 4 shows the HMM deployment profile for FY 1998–2002 that we developed. The vertical axis shows squadron-equivalents devoted to the various categories of deployments. As discussed above, we used a factor of 1/4 for HMM MEU deployments and the pre-deployment training work-ups, 1.0 for HMM UDP deployments, and 1/4 for HMM exercise support.

These data show that 1/2 to 1 squadron equivalent is typically devoted to exercise support.

Figure 4. HMM deployment profile, FY 1998-2002



Peacetime squadron requirement

HMM squadrons support their rotational deployments with close to a 4:1 rotation base. We estimate the peacetime squadron requirement to be:

Deployed squadron equivalents	1 1/2 - 1 3/4
4:1 rotation base multiple	<u> x 4 </u>
	6 - 7
Plus exercise support	<u> 1/2 - 1 </u>
Total peacetime requirement	6 1/2 - 8

HMLA

Structure

There are currently six HMLA squadrons in the active force. Each HMLA squadron includes 18 AH-1W attack helicopters and 9 UH-1N utility helicopters. The Marine Corps is upgrading both aircraft models to four-bladed versions with more power, speed, and range.

The HMLA squadrons are based as follows:

- Two squadrons are permanently assigned to the 2d MAW and based at MCAS New River, NC.
- Four squadrons are permanently assigned to the 3rd MAW and based at MCAS Camp Pendleton, CA.

Deployment patterns

Rotational deployments

HMLA squadrons support three rotational deployments:

- The 2d MAW supports one six-month rotational MEU deployment aboard amphibious shipping from the east coast of the United States to the Mediterranean. This deployment is supported with four AH-1Ws and two UH-1Ns from an HMLA.
- The 3rd MAW supports one six-month rotational MEU deployment aboard amphibious shipping from the west coast of the United States to the Western Pacific. This deployment is supported with four AH-1Ws and three UH-1Ns from an HMLA.
- The 3rd MAW also supports one six-month rotational deployment to Okinawa, Japan, as part of the unit deployment program (UDP). This forward-deployed squadron provides a detachment of four AH-1Ws and two UH-1Ns to the 31st MEU.

There are typically one full squadron and two six-plane detachments deployed. Therefore 1-2/3 squadron equivalents are typically deployed at any given time, and 2/3 squadron equivalent in the six-month MEU pre-deployment training work-up.

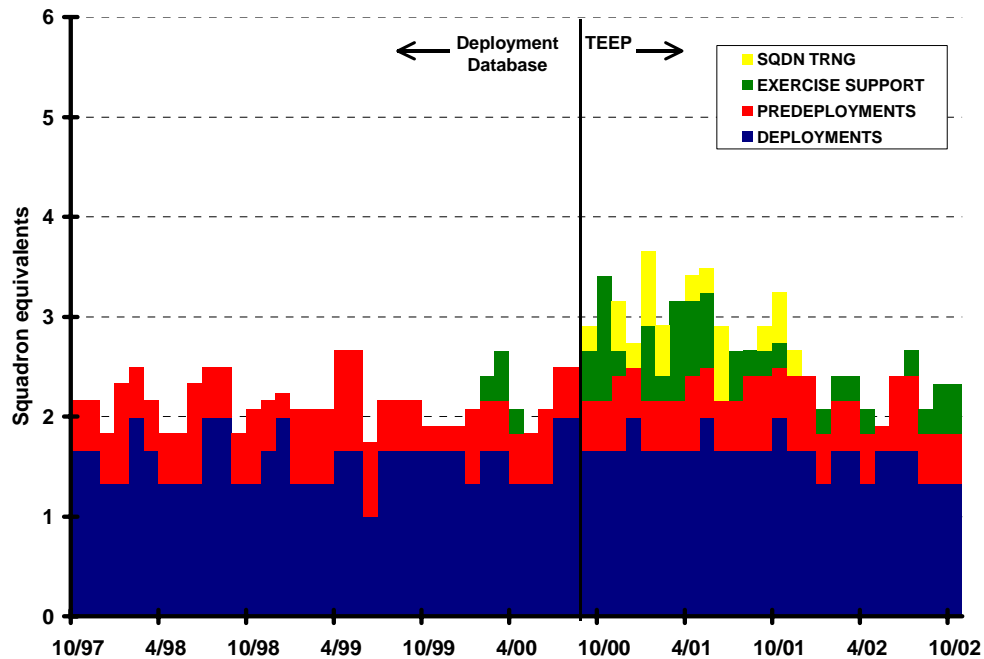
Exercise support

HMLA squadrons support exercises involving ground forces that emphasize offensive air support, such as Combined Arms Exercises. Generally, exercises are supported with small HMLA detachments. Based on our knowledge of Marine Corps training, we assume that 1/4 squadron equivalent is typically provided to support exercises.

Deployment profile

Figure 5 shows the HMLA deployment profile for FY 1998-2002 that we developed. As discussed above, we used a factor of 1/3 for HMLA MEU deployments and the pre-deployment training work-ups, 1 for UDP deployments, and 1/4 for HMLA exercise support.

Figure 5. HMLA deployment profile, FY 1998-2002



The figure shows that 1/2 to 1 squadron equivalent is typically devoted to exercise support.

Peacetime squadron requirement

HMLA squadrons use close to a 4:1 rotation base. We estimate the peacetime squadron requirement to be:

Deployed squadron equivalents	1 2/3 - 2
4:1 rotation base multiple	<u> x 4 </u>
	6 2/3 - 8
Plus exercise support	<u> 1/2 - 1 </u>
Total peacetime requirement	7 1/6 - 9

VMA

Structure

There are currently seven VMA squadrons in the active force. Each VMA squadron is structured around 16 AV-8Bs. The Marine Corps intends to replace all its AV-8B aircraft with the Joint Strike Fighter (JSF) aircraft.

The VMA squadrons are based as follows:

- Three squadrons are permanently assigned to the 2d MAW and based at MCAS Cherry Point, NC.
- Four squadrons are permanently assigned to the 3rd MAW and based at MCAS Yuma, AZ.

Deployment patterns

Rotational deployments

VMA squadrons support three rotational deployments:

- The 2d MAW supports one six-month rotational MEU deployment aboard amphibious ships from the east coast of the United States to the Mediterranean Sea with a six-plane detachment.
- The 3rd MAW supports one six-month rotational MEU deployment aboard amphibious ships from the west coast of the United States to the Western Pacific with a six-plane detachment.
- The 3rd MAW also supports one six-month rotational deployment to Okinawa, Japan, as part of the UDP. This forward-deployed squadron provides a detachment of six AV-8Bs to the 31st MEU.

Typically, a six-plane AV-8B detachment deploys with each of the two MEUs from the continental United States. There is some overlap of successive MEUs. There is also an entire VMA squadron

forward-deployed to Okinawa. So generally there are 1-2/3 to 2 VMA squadron equivalents deployed on rotational deployments.

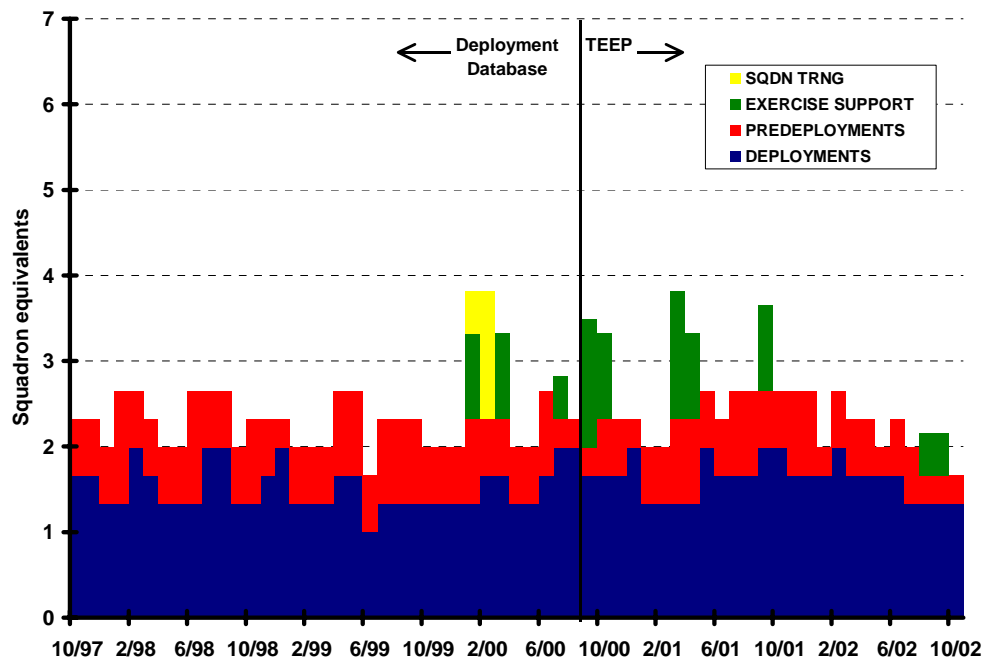
Exercise support

VMA squadrons participate in exercises that emphasize aviation support to ground forces as well as large-scale aviation exercises. Based on our knowledge of Marine Corps exercises we assume that typically 1/3 of a VMA squadron, on average, is involved in these exercises.

Deployment profile

Figure 6 shows the VMA deployment profile for FY 1998-2002 that we developed. As discussed above, we used a factor of 1/3 for VMA MEU deployments and the pre-deployment training work-ups, 1 for UDP deployments, and 1/3 for VMA exercise support.

Figure 6. VMA deployment profile, FY 1998-2002



These data show 1 to 1-1/2 squadron equivalents are typically devoted to exercise support.

Peacetime squadron requirement

VMA squadrons support their rotational deployments on something close to a 3:1 rotation base. We estimate the peacetime squadron to be:

Deployed squadron equivalents	1 2/3 - 2
3:1 rotation base multiple	<u> x 3 </u>
	5 - 6
plus exercise support	<u>1 - 1 1/2</u>
total peacetime requirement	6 - 7 1/2

VMFA/VMFA(AW)

Structure

There are currently eight VMFA squadrons and six VMFA(AW) squadrons in the active force. Each VMFA squadron is structured around 12 F/A-18Cs; each VMFA(AW), around 12 F/A-18Ds. The Marine Corps intends to replace both F/A-18C and F/A-18D aircraft with the JSF aircraft.

The VMFA/VMFA(AW) squadrons are based as follows:

- Four VMFA and three VMFA(AW) squadrons are permanently assigned to the 2d MAW and based at MCAS Beaufort, SC.
- Three VMFA and three VMFA(AW) squadrons are permanently assigned to the 3rd MAW and based at MCAS Miramar, CA.
- One VMFA squadron is permanently assigned to the 1st MAW and based at MCAS Iwakuni, Japan.

Deployment patterns

Rotational deployments

VMFA squadrons support four rotational deployments:

- The 2d MAW supports two six-month rotational carrier air wing (CVW) deployments from the east coast of the United States.

- The 3d MAW supports two six-month rotational CVW deployments from the west coast of the United States to the Western Pacific.

VMFA (AW) squadrons support two rotational deployments:

- The 2d MAW supports one six-month rotational deployment to MCAS Iwakuni, Japan, as part of the UDP.
- The 3d MAW supports one six-month rotational deployment to MCAS Iwakuni, Japan, as part of the UDP.

The Marine Corps provides F/A-18s to only four of the Navy's CVWs, so that at times there are no F/A-18s deployed aboard carriers, and there is the possibility that as many as four VMFA squadrons could be deployed aboard carriers at one time. The VMFA squadrons' associated CVWs participate fully in the pre-deployment training work-ups.

Exercise support

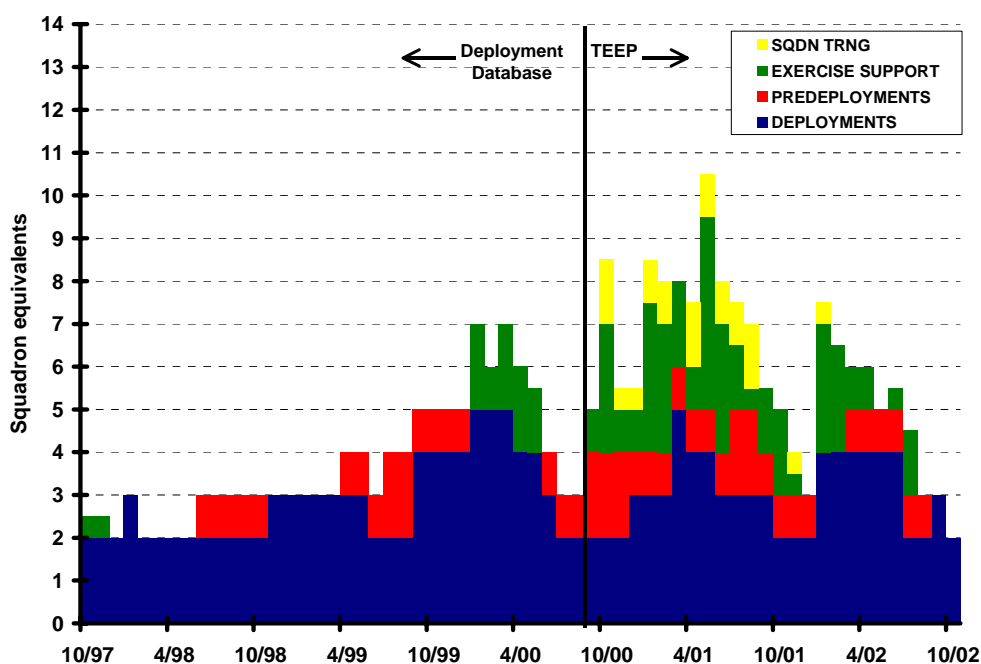
VMFA and VMFA(AW) squadrons participate in exercises that emphasize aviation support to ground forces as well as large-scale aviation exercises. Based on our knowledge of Marine Corps exercises, we assume that typically 1/2 of a VMFA or VMFA(AW) squadron, on average, is involved in these exercises.

Deployment profile

Figure 7 shows the combined VMFA/VMFA(AW) deployment profile for FY 1998-2002 that we developed. As discussed above, we used a factor of 1 for VMFA CVW deployments and the pre-deployment training work-ups, 1 for VMFA(AW) UDP deployments, and 1/2 for VMFA and VMFA(AW) exercise support.

The figure above shows that 2 to 4 squadron equivalents are typically devoted to exercise support.

Figure 7. VMFA/VMFA(AW) deployment profile, FY 1998-2002



Peacetime squadron requirement

VMFA/VMFA(AW) squadrons use close to a 3:1 rotation base. We estimate the peacetime squadron requirement to be:

Deployed squadron equivalents	2 - 4
3:1 rotation base multiple	<u>x 3</u>
	6 - 12
Plus exercise support	<u>2 - 4</u>
Total peacetime requirement	8 - 16

VMAQ

Structure

There are currently four VMAQ squadrons in the active force. Each VMAQ is structured around five EA-6B aircraft. These aircraft squadrons are considered to be national assets, because of the relative paucity of tactical airborne electronic warfare capability.

All four VMAQ squadrons are permanently assigned to the 2d MAW and based at MCAS Cherry Point, NC.

Deployment patterns

Rotational deployments

VMAQ squadrons support one long-standing six-month rotational UDP deployment to the 1st MAW at MCAS Iwakuni, Japan. However, in recent years EA-6B have been supporting other rotational contingency deployments in Europe and the Middle East.

Exercise support

VMAQ squadrons participate in large-scale aviation exercises. Based on our knowledge of Marine Corps exercises we assume that typically an entire VMAQ squadron participates in these types of exercises.

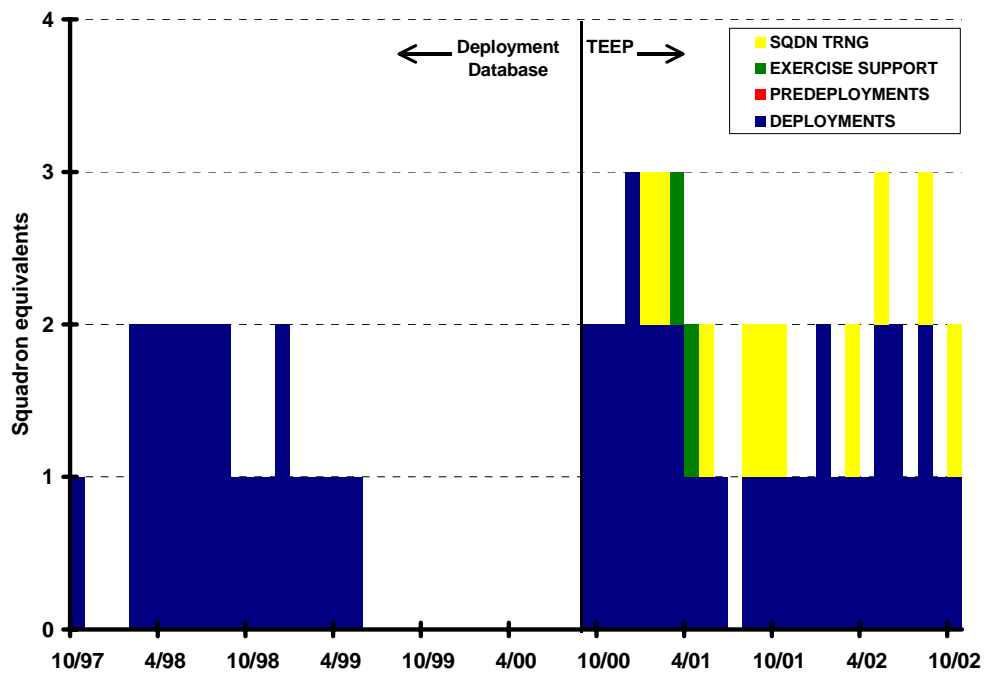
Deployment profile

Though our data are incomplete, particularly for FY 2000, it is clear that the Marine Corps' four VMAQ squadrons are in great demand. As figure 8 shows, during FY 1998-2002, two to three squadrons were or will be deployed during about a third of that period. This is a very high deployment tempo.

Current deployment tempo for the VMAQ squadrons justifies a requirement for more than the current number of four squadrons. The 3:1 rotation base rule would suggest that three squadrons are required to maintain the single UDP rotation to the 1st MAW. However, in addition to that rotational deployment, VMAQs have been committed to long contingency operations. Those commitments were met by rotating the four VMAQs to those contingencies as well.

We estimate the VMAQ peacetime squadron requirement to be at least four.

Figure 8. VMAQ deployment profile, FY 1998-2002



VMGR

Structure

There are currently three VMGR squadrons in the active force. Each VMGR includes 12 KC-130 aircraft. The squadrons are based as follows:

- One squadron is permanently assigned to the 2d MAW and based at MCAS Cherry Point, NC.
- One squadron is permanently assigned to the 3rd MAW and based at MCAS Miramar, CA.
- One squadron is permanently assigned to the 1st MAW and based at MCAS Futenma on Okinawa, Japan.

Deployment and employment patterns

VMGR employment patterns are quite different from those of other Marine Corps aircraft. A detachment of two KC-130s is assigned to each deploying MEU as a “stand-by detachment.” This detachment trains with the MEU ACE during the pre-deployment work-up, but does not deploy aboard amphibious ships with the rest of the MEU. Rather, the detachment is available to fly to a land base near the MEU’s operating area on short notice, if required. This is not a very large commitment, in that it includes only a small fraction of a squadron’s aircraft.

Typically KC-130s provide a lot of logistics support and aerial refueling support for Marine ground and aviation forces. We examined flying hour data from the recent past to understand the level of effort expended to provide this support.

Table 2 summarizes active force KC-130 flight hour data for FY 1996-99 by several categories, including training, training support, and operations support. The training support totals are further broken down into logistics support, transportation/troop support, and other. The data show very heavy use of the KC-130s with a large portion of those flight hours going to support Marine aviation and ground forces.

Table 2. Active force KC-130 flight hour totals by category, FY 1996-99^a

Flight purpose	Special/general flight purpose	Number of hours flown	Average hours flown per aircraft per month ^b
Training		41,971	24.3
Training support			
	Logistics support	30,495	17.6
	Transportation/troop support	21,100	12.2
	Other	30,463	17.6
	Subtotal	82,058	47.5
Operations support		626	0.4
Total		124,655	72.1

a. These data are based on NAVFLIRS data summarized in [5], which dissected Marine aviation flying hours in a variety of different ways based on specific and general purpose codes.

b. Based on nominal figure of 36 aircraft in three active force VMGR squadrons, [5].

These data show that KC-130 aircraft fly a lot of hours, but [5] also found that KC-130s generally fly very long missions. By one definition of a mission, they average 4.6 hours in duration. It is difficult to use these data to make an argument for the number of squadrons required to meet the Marine Corps' needs. However, the sheer magnitude of flight activity for logistics support and transportation/troop support (29.8 hours per aircraft per month over a four-year period) makes a compelling case that at least three squadrons are required.

The future Marine aviation inventory will include aircraft with longer ranges, which suggests that there may be less need for KC-130 aerial refueling capabilities. On the other hand, another aircraft, the MV-22, will be capable of in-flight refueling. MV-22 aerial refueling requirements are not addressed in this study. Further analysis with respect to additional demands on the KC-130J will be needed, to include self-deployment of MV-22 into theater.

We estimate the VMGR peacetime squadron requirement to be three.

Summary of results and squadron requirements

We summarize our results in this section, and translate VMA and VMFA/VMFA(AW) peacetime squadron requirements into JSF peacetime squadron requirements.

Table 3 summarizes the peacetime squadron requirements analyzed in the preceding sections of this research memorandum. These requirements are characterized in terms of a range of squadrons and rounded to the nearest squadron.

Table 3. Summary of peacetime squadron requirements

Squadron type	Squadron requirement			
	Rotational deployments	Exercise support	Total: 3:1 rotation base ^a	Total: 4:1 rotation base ^b
HMM	3 - 4	2 - 3	11 - 15	14 - 19
HMH	1 1/2 - 1 3/4	1/2 - 1	5 - 6	7 - 8
HMLA	1 2/3 - 2	1/2 - 1	6 - 7	7 - 9
VMA	1 2/3 - 2	1 - 1 1/2	6 - 8	8 - 10
VMFA/VMFA(AW)	2 - 4	2 - 4	8 - 16	10 - 20
VMAQ ^c	1 - 3	—	4+	4+
VMGR ^d	—	—	3	3

a. We multiplied the “rotational deployments” range by 3, added the “exercise support” range, and rounded to whole squadrons.

b. We multiplied the “rotational deployments” range by 4, added the “exercise support” range, and rounded to whole squadrons.

c. We did not carry out a calculation using a rotation base assumption. The current structure of four VMAQ squadrons is very heavily tasked with up to three squadrons deployed at times.

d. Our estimate of VMGR peacetime squadron activity is based on an analysis of flight hour activity, which suggests that three squadrons are required to meet peacetime needs.

Peacetime JSF squadron requirements

The Marine Corps intends to use JSF aircraft to replace three T/M/S aircraft: the AV-8B, the F/A-18A/C, and the F/A-18D. These current inventory aircraft are organized in 16-plane VMA, 12-plane VMFA, and 12-plane VMFA(AW) squadrons, respectively. Translating the VMA and VMFA/VMFA(AW) peacetime requirements into peacetime JSF squadron needs, requires several assumptions.

We assume that JSF squadrons will comprise 12 aircraft. Thus the VMFA/VMFA(AW) translation to JSF is a straightforward one for one squadron replacement. This implies similar squadron deployment and exercise patterns. That is,

Deployed squadron equivalents	2 - 4
3:1 rotation base multiple	<u>x 3</u>
	6 - 12
Plus exercise support	<u>2 - 4</u>
Total peacetime requirement	8 - 16

The JSF squadron-for-VMA translation is trickier. Currently, VMA squadrons provide six-plane detachments to MEUs deploying from the east and west coasts of CONUS, as well as, full squadron UDP rotation to the 3rd MAW. We work out the translation for two cases:

- In the first case, we assume that MEUs will be supported by a six-plane JSF detachment—or half a JSF squadron.
- In the second, we assume that MEUs will be supported by a full JSF squadron. Perhaps, with up to ten aircraft deployed aboard amphibious ships with the MEU.³

MEU supported by half of a JSF squadron

In this case, 2 to 2-1/2 squadron equivalents would be committed to rotational deployments (1 to the UDP and 2 to 3 half-squadrons to

3. Our analysis of the MEU ACE provides more information on the JSF detachment of the 2015 MEU ACE. The JSF's multimission capabilities and the need to escort the MV-22, among other things, suggest that the MEU requires more than six JSF.

MEUs deployed from the continental United States). One to 1-1/2 squadron equivalents would be committed to exercise support. Assuming a 3:1 rotation base implies:

Deployed squadron equivalents	2 - 2 1/2
3:1 rotation base multiple	<u> x 3</u>
	6 - 7 1/2
Plus exercise support	<u>1 - 1 1/2</u>
Subtotal	7 - 9
Plus translated VMFA/VMFA(AW)	<u>8 - 16</u>
Total peacetime requirement	15 - 25

If we assume a 4:1 rotation base, then JSF squadron requirements are:

Deployed squadron equivalents	2 - 2 1/2
4:1 rotation base multiple	<u> x 4</u>
	8 - 10
Plus exercise support	<u>1 - 1 1/2</u>
Subtotal	9 - 11 1/2
Plus translated VMFA/VMFA(AW)	<u>8 - 16</u>
Total peacetime requirement	17 - 27 1/2

MEU supported by entire JSF squadron

In this case, 3 to 4 squadron equivalents would be committed to rotational deployments (1 to the UDP and 2 to 3 to MEUs deployed from the continental United States). One to 1-1/2 squadron equivalents would be committed to exercise support. Assuming a 3:1 rotation base implies:

Deployed squadron equivalents	3 - 4
3:1 rotation base multiple	<u> x 3</u>
	9 - 12
Plus exercise support	<u>1 - 1 1/2</u>
Subtotal	10 - 13 1/2
Plus translated VMFA/VMFA(AW)	<u>8 - 16</u>
Total peacetime requirement	18 - 29 1/2

If we assume a 4:1 rotation base, then JSF squadron requirements are:

Deployed squadron equivalents	3 - 4
4:1 rotation base multiple	<u>x 4</u>
	12 - 16
Plus exercise support	<u>1 - 1 1/2</u>
Subtotal	13 - 17 1/2
Plus translated VMFA/VMFA(AW)	<u>8 - 16</u>
Total peacetime requirement	21 - 33 1/2

Future peacetime squadron requirements

Table 3, above, summarizes the peacetime squadron requirements in terms of a range of squadrons. We also make a point estimate of peacetime squadron requirements, which are summarized in table 4. For rotary-wing aircraft and the MV-22, we use the mid-point of the 4:1 rotation base range; we use the mid-point of the 3:1 rotation base for fixed-wing aircraft. Peacetime JSF squadron requirements may be derived from peacetime VMA and VMFA/VMFA(AW) squadron requirements in several different ways, using different assumptions, above. The peacetime JSF squadron point estimate we report assumes a 12-plane JSF squadron and assumes that an entire squadron supports each MEU deployment.⁴

The VMM squadron requirement is based on peacetime HMM squadron and CH-53D HMH squadron requirements. We assume that VMM squadrons will support the same rotational deployment and exercise support commitments that the helicopters they are replacing support. The HMM squadron requirement is 17 squadrons (see table 3). The total HMH (CH-53Es and CH-53Ds) requirement is 8 squadrons. CH-53Ds represent about 25 percent of the HMH requirement (30 of 126 total aircraft), or 2 squadrons. Thus we put the peacetime VMM squadron requirement at 19 and the CH-53E HMH requirement at 6 squadrons.

4. Reference [1] suggests this is the 2015 MEU ACE requirement.

Table 4. 2015 peacetime squadron requirement, by T/M/S.

Squadron type	Aircraft	Peacetime requirement
VMM	V-22	19
HMH	CH-53E	6
HMLA	AH-1Z, UH-1Y	8
JSF	JSF	24
VMAQ	EA-6B	4
VMGR	KC-130	3

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